

The Effects of Radiation on Imagery Sensors in Space

Recent experience using high definition video on the International Space Station reveals camera pixel degradation due to particle radiation to be a much more significant problem with high definition cameras than with standard definition video. Although it may at first appear that increased pixel density on the imager is the logical explanation for this, the ISS implementations of high definition suggest a more complex causal and mediating factor mix. The degree of damage seems to vary from one type of camera to another, and this variation prompts a reconsideration of the possible factors in pixel loss, such as imager size, number of pixels, pixel aperture ratio, imager type (CCD or CMOS), method of error correction/concealment, and the method of compression used for recording or transmission. The problem of imager pixel loss due to particle radiation is not limited to out-of-atmosphere applications. Since particle radiation increases with altitude, it is not surprising to find anecdotal evidence that video cameras subject to many hours of airline travel show an increased incidence of pixel loss. This is even evident in some standard definition video applications, and pixel loss due to particle radiation only stands to become a more salient issue considering the continued diffusion of high definition video cameras in the marketplace.

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Importance of Imagery

- Imagery taken during manned space flight is important in conveying information to the crew, operational ground support teams, scientists and the public.
- NASA and the International Space Station Partners are interested in the benefits of using HDTV in space.
- HDTV cameras have been flown on the Space Shuttle and the ISS since the late 1990s.
- While all of the cameras flown have produced stunning imagery, they have also experienced imagery sensor degradation over time (pixel hits)

Imagery Sensor Degradation

- Previously SD camcorders experienced some degradation but was minimal compared to HD camcorders.
- Initially our theory was that it was due to increased pixel density of the imager.
- As more HD camcorders were flown the degree of damaged from one camera to the next.

Contributing factors

- Imager size
- Pixels per imager
- Shape and size of individual pixels
- Pixel shifting and interpolation
- Imager type CCD or CMOS
- Error correction and concealment methods
- Compression techniques used in recording and transmission
- Temperature of imager

